Desorption

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Desorption is a phenomenon whereby a substance is released from or through a surface. The process is the opposite of sorption (that is, adsorption and absorption). This occurs in a system being in the state of sorption equilibrium between bulk phase (fluid, i.e. gas or liquid solution) and an adsorbing surface (solid or boundary separating two fluids). When the concentration (or pressure) of substance in the bulk phase is lowered, some of the sorbed substance changes to the bulk state.

In chemistry, especially chromatography, desorption is the ability for a chemical to move with the mobile phase. The more a chemical desorbs, the less likely it will adsorb, thus instead of sticking to the stationary phase, the chemical moves up with the solvent front.

In chemical separation processes, stripping is also referred to as desorption as one component of a liquid stream moves by mass transfer into a vapor phase through the liquid-vapor interface.

After adsorption, the adsorbed chemical will remain on the substrate nearly indefinitely, provided the temperature remains low. However,as the temperature rises, so does the likelihood of desorption occurring. The general equation for the rate of desorption is:

$$R = rN^x,$$

where r is the rate constant for desorption, N is the concentration of the adsorbed material, and x is the kinetic order of desorption.

Usually, the order of the desorption can be predicted by the number of elementary steps involved:

Atomic or simple molecular desorption will typically be a first-order process (i.e. a simple molecule on the surface of the substrate desorbs into a gaseous form).

Recombinative molecular desorption will generally be a second-order process (i.e. two hydrogen atoms on the surface desorb and form a gaseous H_2 molecule).

The rate constant r may be expressed in the form

$$r = Ae^{-E_a/kT}$$

where A is the "attempt frequency" (often the Greek letter ν), the chance of the adsorbed molecule overcoming its potential barrier to desorption, E_a is the activation energy of desorption, k is the Boltzmann constant, and T is the temperature.

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